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An Empirical Analysis of The Contract Year Phenomenon in the National Football League

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May 2, 2018

A Thesis Submitted to the Department of Economics

Skidmore College

This thesis is submitted in partial fulfillment of the requirements for the course Senior Seminar (EC 375) during the Spring Semester of 2018

While writing this thesis, I have not witnessed any wrongdoing, nor have I personally violated any conditions of the Skidmore College Honor Code

Name: Nicholas Fronte

Signature: _____

Abstract

This paper seeks to find evidence of the contract year phenomenon in the National Football League. The contract year phenomenon is the idea that players outperform their usual level of performance in the season prior to their free agency eligibility. Furthermore, the concept is predicated on fluctuations in effort exerted by players. The best method for measuring these fluctuations in effort is through performance statistics. In this study, I chose to measure player productivity in terms of an advanced performance statistic. For the empirical analysis, I studied 59 players from different offensive positions who signed contracts under the 2011 Collective Bargaining Agreement. The results suggest that being in a contract year has a positive effect on player productivity, while being in the season after signing a new contract has a negative effect on player productivity. However, my analysis yielded no statistically significant results.

I. Introduction

Through my research, I will try to find evidence of the contract year phenomenon in the National Football League (NFL). The contract year phenomenon is the idea that athletes perform at a high level in the season prior to their free agency eligibility. In a contract year, the term used to describe the year before contract expiry, players are motivated by their ability to affect future wages. Essentially, if they perform at a high level during their contract year, they will be rewarded with a favorable contract and salary.

Stiroh (2007) studied the effects of the contract year phenomenon in the National Basketball Association (NBA) from 1988 to 2002. Asymmetric information prevents teams from monitoring their athletes' effort levels. This allows players to engage in strategic behavior, which is defined as an increase in effort in response to an incentive, and shrinking behavior, which is defined as a decrease in effort in response to the lack of an incentive. Using basic statistics such as points, rebounds, and assists, to measure productivity, Stiroh (2007) found evidence of strategic behavior, but not shrinking behavior in the NBA. Jean (2010) conducted a similar study when he tried to find evidence of the contract year phenomenon in the NBA from 2001-2009. Instead of measuring production in terms of basic statistics, Jean (2010) uses an advanced statistic, called player efficiency. Jean (2010) found evidence of both strategic and shrinking behavior. O'Neill (2013) studied the contract year phenomenon in another professional sports league, Major League Baseball (MLB). The study hypothesized that the stipulations included in the 2006 Collective Bargaining Agreement would induce opportunistic behavior in MLB players. Using OPS as a means of measuring production, O'Neill (2013) found evidence of the contract year phenomenon in the MLB.

Sen and Rice (2011) studied fluctuations in players' effort throughout the contract cycle and their careers in the NBA. The results found that players exert less effort in the early years of their contract than in later years. This is because players discount the future early in the contract

cycle, but then increase effort when contract expiry is imminent. Moreover, the study found that veteran players exert less effort than younger players when at the same stage in the contract cycle.

Ichniowski and Preston (2012) studied whether unexpected performance during the NCAA "March Madness" tournament impacts a player's draft position. On a broader scale, they studied the decision-making biases employed by professional sports teams. "Availability heuristic" is the idea that decisions are based on recent and vivid examples of events. This applies to the contract year phenomenon because teams base their opinions on players based on their contract year performance and then make decisions accordingly. On the other hand, "slow thinking" is the idea that decision-making biases are eliminated when there is time for information to be reviewed and processed before a decision is made. The study found that unexpected performance in the NCAA tournament does impact a player's draft position, thus finding evidence of professional teams being influenced by decision-making biases.

While evidence of the contract year phenomenon has been found in other professional sports leagues, such as the NBA and MLB, no studies to date have found evidence of the contract year phenomenon in the NFL. This has to do with the structure of the league's contracts. Professional sports contracts primarily contain three means of compensating players: a signing bonus, performance incentives, and guaranteed money. A signing bonus is given to the player upon signing the contract. Performance incentives are a set of statistical goals that can earn players a certain amount of money if he achieves them. For example, NFL tight end Rob Gronkowski earned $3 million when he recorded 1,000 receiving yards during the 2017 season. Had Gronkowski not accumulated 1,000 receiving yards, the team would have not been obligated to pay him that $3 million. On the other hand, guaranteed money is paid to the player regardless of their performance, or even if they are traded or remove from the roster entirely. Performance incentives undermine the contract year phenomenon, while guaranteed money substantiates it. Historically, NFL contracts contained a small amount of guaranteed money and a large amount

of performance incentives This allowed teams to easily cut or trade players who were not performing at par with their value. However, since the 2011 Collective Bargaining Agreement (CBA), NFL contracts have included a greater percentage of guaranteed money along with better player benefits. Because of this, I believe that players who signed contracts since 2011 CBA have been subject to the contract year phenomenon.

The sequence of the paper will occur as follows: Section II discusses the relevant literature to my research, that includes previous contract year phenomenon studies, as well as the theory behind it. Section III outlines the analytical framework of this paper, followed by Section IV which describes the data used in the study. Section V discusses the results of my regression analysis, while Section VI provides a discussion of the results. Finally, Section VII reviews the limitations of the study and considers areas for future research.

II. Literature Review

1. Playing For Keeps: Pay and Performance in the NBA

Employing a dataset of professional basketball players in the National Basketball Association (NBA) from 1988 to 2002, this paper seeks to examine whether multi-year contracts causes players to alter their effort over a contract cycle. This paper hypothesizes that players will perform at an above average level in the year prior to free agency, but then their performance will decrease is the subsequent years after signing a contract. This is referred to as opportunistic behavior, but more specifically strategic and shrinking behavior. This terminology is introduced by Maxcey et al. (2002) and is used to describe potential worker behavior under circumstances of asymmetric information. Strategic behavior describes the phenomenon that players want to increase their perceived value leading up to their free agency eligibility, thus increasing their effort and bettering their performance. On the other hand, shrinking behavior describes the idea that

players lack an incentive to perform after signing a contract, thus decreasing their effort and causing their productivity to suffer. This theory is predicated on the assumption that better performance leads to more lucrative contracts. Stiroh (2007) asserts that a one point increase in a player's scoring average is associated with an annual salary increase of over $300,000. However, there are some flaws with employing the idea of shrinking behavior. Yes, there is a lack of incentive to perform after the player signs a new contract; however, a vast majority of professional athletes sign multiple contracts throughout their careers. Therefore, it would be foolish for a player to completely slack off because that could negatively affect his future contracts and wages. Even worse, a player could be removed from the league entirely if his performance suffers greatly enough. This is a topic that will be addressed in the later literature.

This paper cites asymmetric information and moral hazard as the theory responsible for causing the contract year phenomenon. First, asymmetric information is in regards to the effort exerted by players and their employers inability to monitor it. Because of the visibility and competitiveness of professional sports, players are unlikely to shrink their effort during games. However, off-season conditioning and in-season practice habits, which performance is predicated on, have been identified as areas where athletes might slack off due to a lack of incentives. Moral hazard comes into play when looking at how a player will act when he is protected against losses. Players will alter their effort as a means to maximize personal gains and sign a lucrative contract. After signing the contract, the player no longer has an incentive to exert maximum effort because he has already attained what he worked for. Therefore, the player knows that if he does not perform at a high level, he still will receive a favorable compensation. Furthermore, the length of the contract as well as the player's age are important to consider. Longer contracts are deemed safer for players, and thus should be more likely to contribute to the contract year phenomenon. This is the rationale that Stiroh (2007) and Jean (2010) use when justifying only including players who signed multi-year contracts in their studies.

First looking at the relationship between individual performance and wages, this paper found that performance in the contract year leads to longer, more lucrative contracts. One of the most significant coefficients in the regression was age, which showed that older players were more likely to receive less lucrative contracts than younger players. This is likely due to the fact that teams want to reserve more lucrative contracts for younger players, who are more probable to be productive for a greater number of years than older players. In regards to the contract year phenomenon, this would imply that younger players are more likely to exhibit strategic behavior because they have a better chance to receive a lucrative contract. On the other hand, older players know that regardless how well they perform, their is a ceiling for how much they will be compensated as teams are not willing to allocate substantial funds to a player who many not remain productive for much longer. The study also found that employers take into account a player's historical performance along with his contract year performance when evaluating that player's value. This suggests there is a complex process in determining employers' perceptions of worker ability. The door is open for the contract year phenomenon if employers place more value on contract year performance rather than historical performance.

The main finding of the study found that player performance increases in the contract year and then decreases in the post-contract era. The study used a number of statistics to determine player productivity (points, rebounds, assists, etc.), but one of the more interesting statistics used was minutes played, or a player's usage. If a player is performing at a high level on the court, then he will be rewarded with more minutes played. Thus, the study found that players' usages in a contract year increases, which is an indication that players' overall performances were also increasing. This can be transposed into the NFL by using snap counts or games started. Coaches reward their most productive players with more snaps or starts.

Moreover, the study found that longer contracts are associated with a smaller post-contract decline. This is likely due to the fact employers heavily vet players who receive long term contracts. As I mentioned earlier, the study concluded that employers consider a combination of

a player's historical performance along with his contract year performance during contract negotiations. For players who receive long term contracts, employers most likely place a greater weight on historical performance, which is likely a better indicator of future player performance. By placing a greater weight on historical performance during contract negotiations, teams reduce their chances of accentuating the contract year phenomenon.

One major drawback of the study was how it chose to measure productivity. Productivity was measured in terms of basic statistics such as rebounds, assists, points, etc. As mentioned, these statistics can be misleading because they do not control for external variables. This may explain why Jean (2010) found evidence of shrinking behavior in the NBA through his use of an advanced metric as his dependent variable. Furthermore, Stiroh (2007) employed an older dataset than Jean (2010). The evolution of player contracts during this time may have been a factor in the dissimilarity of these studies' results. Over the past decades, contracts have become more favorable for players in terms of benefits and compensation. More favorable contracts are a factor that would substantiate the contract year phenomenon, as players would be more incentivized to exhibit strategic behavior. This is an idea that I will elaborate on when discussing the role of collective bargaining agreements on the evolution of professional athletes contracts.

2. Performance Variation in the NBA: Guaranteed Contracts and the Contract Year Phenomenon

Jean (2010) sought to continue with study of Stiroh (2007) and examine the presence of strategic and shrinking behavior in the National Basketball Association (NBA) with his research. However, Jean (2010) qualified the study conducted by Stiroh (2007) by using a player efficiency statistic as the dependent variable in this study. This statistic, deemed an advanced metric, can better gauge player performance than basic statistics such as points, rebounds, and assists, which were used by Stiroh (2007). Because of how new advanced analytics are in professional

sports, only recent contract year phenomenon studies ploy them as production statistics whereas older studies use basic statistics. This disparity in measuring player productivity will lead to different results among similar studies, which we can see when comparing this study to that of Stiroh (2007).

As mentioned, many external factors affect player performance and must be controlled for. Jean (2010) acknowledges that age and experience will affect a player's performance in their respective ways. Age's relationship with player performance can best be described as parabolic. Players productivity typically increases from when they enter the league to when they are older, until a certain point and then physical shortcomings inhibit their performance. On the other hand, experience can only increase player performance, but at a decreasing rate. Another external factor that needs to be controlled for is injuries. Quite obviously, injuries will have a negative effect on player productivity, regardless of their severity. In this study, games played each season were accounted for in order to control for player injuries. Finally, player performance is usually a function of overall team performance. In order to control for this, Jean (2010) included team winning percentage as an independent variable. While this may be an appropriate control for studying the contract year phenomenon in the NBA, this cannot be transposed to an NFL contract year phenomenon study. The first reason is because an NBA season consists of 82 games, while an NFL season consists of just 16. Subsequently, there will be much less contrast between team's winning percentages in the NFL because of their short season. Furthermore, team win percentage is a culmination of offensive and defensive productivity. Unlike in the NBA, an NFL team's defense and offense are never on the field at the same time. Moreso, NFL players exclusively play either defense or offense, very rarely both. This means that an offensive player's performance will be mainly influenced by other offensive players, rather than the team's performance as a whole. Many times, we see an NFL team have a productive offense and not a productive defense, or vise versa. For example, the 2017 New England Patriots epitomized the disparity that exists between offense and defense. Their weighted offense ranked first in the league, while their

weighted defense ranked ranked second to last (Football Outsiders). This factor, among many others, represents the differences between football and other professional sports and thus emphasizes the need to account for such differences in my study.

Jean (2010) compiled a data set 231 players from 2001-2009. In order to narrow down the data set and account for players most prone to the contract year phenomenon, the study only included players who signed at least a two year contract. The rationale behind this is that when players succumb to the contract year phenomenon, they increase their performance as a means to receive a favorable contract. A "favorable contract" is not only in regards to compensation, but also the length of the contract. A longer contract provides players with a sense of security, something that will be addressed Sen and Rice (2011). Therefore, players who sign a multi-year contract attained that sense of security and may have exerted strategic behavior to achieve that.

In conclusion, the study found evidence of strategic behavior and shrinking behavior. This is important because it found evidence of the contract year phenomenon in another professional sports league by evaluating player productivity using an advanced metric. This is important when comparing Jean's results to Stiroh's.

3. Moral Hazard in Long Term Guaranteed Contracts: Theory and Evidence From the NBA

Sen and Rice (2011) published a study that studies the effect of being in the final year of a contract on player performance in the NBA. The paper modeled this interaction as a 3-period principal-agent game between the team, who is risk neutral, and the player, who is risk averse. In each period of the game, the player chooses how much effort he will exert. Because current period wages are already pre-negotiated, the main incentive to put forth effort comes from the ability to affect future wages. At the end of every period, the team updates their belief on a player's ability based on their output, which is a function of ability and effort. A team's belief on a player's ability is the basis for how much they plan to compensate said player in their next contract. Using this

3-period game is a valuable tool in understanding the factors that are prevalent in contract negotiations and identifying which factors manifest themselves into the contract year phenomenon.

In this game, the team must decide between single period and multi period contracts, as well as what periods to administer these contracts in. A team will never offer a three period contract because any rational player would put forth zero effort as their performance has no effect on future wages. The study found that when a team rewards a player with a two period contract, effort will increase over the span of the contract and therefore performance will be better in period two than in period one. This is because players typically discount the future. The effort exerted in period one will only benefit the player in period three when he signs a new contract. However, when contract expiry is iminent in period two, the player expends more effort. Based on this, players who sign one year contracts will not succumb to the contract year phenomenon because there is no opportunity for these players to "discount the future." Single period contracts would mean players are motivated to affect future wages in all three periods, thus exerting maximal effort. These types of contracts should be optimal for teams. However, recall that in this game the players are risk averse. Because they place a high value on security, players are willing to sacrifice compensation in return for longer guaranteed contracts. An example of this is Richard Jefferson, who opted out of the last year in his contract and foregone $14 million to resign with the Spurs on a 4 year, $38.8 million contract (about $9 million annually). Therefore, this study concluded that the Pareto efficient, or mutually beneficial, outcome is a two period contract between the team and the player.

Using the NBA efficiency index as its dependent variable, this study reported results that support the notion previously asserted. The largest decreases in player effort are associated with the earlier years of a long term contract. As stated earlier, this is most likely due to the fact that players discount the future. Once contract expiry seems imminent, mainly in the last year of the contract, effort increases as players become more motivated to perform for future wages. The

study found that a player's effort in the penultimate year of his contract is 7% lower than in the final of the contract. Furthermore, effort in the player's third-to-last year of his contract is 5% lower than in his penultimate year, and effort in the fourth-to-last contract year is 2% lower than in the third-to-last contract year.

This study also compared output for players in long-term contracts at different points in their careers. Based on the coefficients yielded from the regression, the performance of a second-year player in the penultimate year of his contract will 15% less than in his contract year. Conversely, the performance of sixth-year player in the penultimate year of his contract will be 8% less than in his contract year. These results reveal players in the later stages of their careers have less incentive to alter their effort. This is similar to what Stiroh (2007) concluded in his study. Younger players are more likely to fluctuate their effort because they have a greater stream of future wages, whereas older players have a shorter stream of future wages to play for. Another important factor to note is the idea that players discount the future. Younger players, who are typically signed to more long-term contracts than older players, see their effort increase as they approach contract expiry. Because older players will be signed to more short-term contracts, there will be less of a fluctuation in their effort as contract expiry is always in sight.

The study does not acknowledge several factors that may contribute to these results. If a player has spent enough years in the league, he has likely accumulated a sufficient amount of wealth. Therefore, factors other than future wages may be motivating the player at the later stages of his career, such as winning a championship. One example of this is NBA player David West. A highly touted player for many seasons, West opted out of a $12.6 million contract with the Indiana Pacers to sign with the San Antonio Spurs for the veteran's minimum, $1.6 million. Many agree that the basis of this decision was West's desire to win an NBA championship; something that was more likely to happen with the Spurs than the Pacers. After 12 years in the NBA, West has accumulated $87.5 million, but has never won a championship, which is regarded as one of the greatest achievements a player can attain. Moreover, the study does not acknowledge that older

players are typically compensated less than younger players. Teams would rather allocate their funds to young players who have the potential to be productive for a longer amount of time than older players. Because of this, older players might have a lesser incentive to perform because their future wage prospects are not inviting.

4. Does March Madness Lead to Irrational Exuberance in the NBA Draft? High-Value Employee Selection Decisions and Decision-Making Biaas

As stated by Stiroh (2007), teams' perceptions of player ability are a function of a player's historical performance and contract year performance. Based on this perception, the team allocates its funds accordingly. However, it seems irrational for an employer to allow contract year performance to have such a profound effect on an employee's wage. After all, it is a small sample size. In this study, Ichniowski and Preston (2012) study this irrational exuberance exhibited by teams and determine whether it is a valid measure to project future player performance.

This paper studied the decision making rationality of NBA executives and scouts by addressing whether a player's performance in the NCAA "March Madness" college basketball tournament impacts the player's draft status. The study ployed a data set that included players and teams who qualified for the NCAA college championship tournament from 1997-2010. They measured team and player "unexpected" performance by comparing teams' wins and players' stats in the NCAA college championship tournament to their season-long average performance. Using this information, they determined whether players' unexpectedly good or bad March Madness performances affects their draft placement. Furthermore, they studied if unexpectedly good performance during the tournament can be a potential predictor of future success in the NBA. Relating this back to my study, NFL teams exhibit this kind of irrational exuberance when compensating players who enjoy a performance boost in their contract year.

The study cites a copious amount of literature that explains the biases and heuristics used by NBA executives and scouts to make draft decisions. The first category of decision making bias is referred to as “availability heuristic.” This is the idea that decisions are made based on recent, vivid, and dramatic examples of people. This applies to players competing in March Madness for a couple reasons. First, March Madness is the last competition before the NBA draft. Therefore, when NBA executives are making their draft decisions, March Madness is the most recent impression they have of players. Secondly, information on performance in this tournament is widely available. Being that this tournament features a majority of the nation’s top players and teams, NBA scouting of this event is extensive. Consequently, NBA teams may receive more information about a player from this tournament than they did during the regular season. Availability heuristic can also be applied to the contract year phenomenon in the NFL. Players’ contract years are the most recent observations NFL teams have on players’ performances, thus teams may base players’ contracts on their contract year performance. Moreover, NFL teams expend a greater effort scouting players who are in their contract year than in the earlier years of their contract. It would be impractical for teams to scout players who will not enter free agency for a couple years. This may lead to teams receiving a majority of information on players during their contract season and subsequently using this information to compensate them.

Conversely, the study acknowledges that teams have several months to make draft decisions on players and may actually exhibit “slow thinking.” This is the idea that much of decision making bias is caused by people being forced to make decisions quickly. After the NCAA championship tournament, NBA teams have several months to evaluate the extensive information they have on players before they have to make a draft decision. This may eliminate the presence of any decision making bias. The same could be said for the NFL. A majority of NFL players end their season sometime in January. Teams cannot start negotiating or signing players to contracts until mid-March. This leaves a several month window of time for NFL teams to evaluate players’ performances and possibly eliminate any decision making bias.

Based on the regression analysis, the study concluded that draft decisions are affected by unexpected team wins and player scoring. With all else equal, scoring 4 or more points in March Madness improves a player's draft position by 4.7 slots. Furthermore, the study found that players with positive draft bumps due to unexpectedly good performance in March Madness were more likely to become one of the rare NBA superstars in the league. Although the topic of study is not closely related to the contract year phenomenon in the NFL, it found evidence of decision making bias committed by professional sports teams when evaluating players. NFL teams exhibiting availability heuristic when negotiating contracts with players may be substantiating the contract year phenomenon. Moreover, while the study concluded that teams were right to weigh recent tournament performance greater than season long performance, this cannot be applied to contracts in the NFL. The study looked for players who would go on to become superstars, a rare breed of players who exhibit consistent high level perform throughout their career. These types of players are marginally affected, if at all, by the contract year phenomenon and would be outliers in my study.

5. Do Major League Hitters Engage in Opportunistic Behavior

The contract year phenomenon has also been studied in Major League Baseball (MLB). In this study, O'Neill (2013) chose to focus on MLB hitters. The study included 256 MLB free agent hitters playing under the 2006 Collective Bargaining Agreement.

In sports, collective bargaining agreements are labor agreements that reflect the results of collective bargaining between the players and team owners. The agreement sets standards on the distribution of league revenue, contracts, and player benefits, including pension plans and

medical benefits. These agreements have huge implications for player contracts, as teams must abide by the contract standards specified in the latest collective bargaining agreement. In his research, O'Neill (2013) chooses to study players who signed contracts in accordance with the 2006 MLB Collective Bargaining Agreement. This agreement raised the minimum MLB salary and increased player benefits. As a result of this, contracts became more favorable for players and thus might have caused a rise in players exhibiting opportunistic behavior. In regards to studying the contract year phenomenon in the NFL, it would be best to study players who signed contracts after the NFL's 2011 Collective Bargaining Agreement. As the dangers of playing in the NFL became more ubiquitous, the National Football League Players Association (NFLPA) lobbied for increased player benefits early in 2010. These negotiations manifested into an increased minimum salary, increased minimum guaranteed salary, and an increase up to $1.5 million in salary guarantees for injured players. Similar to O'Neill (2013), I believe that players will be more likely to exhibit opportunistic behavior with the improved contract benefits outlined in the 2011 CBA.

As far as the theory behind why the contract year phenomenon exists, the study defers to Stiroh (2007) and the theories he ployed in his research. Due to asymmetric information, a moral hazard exists between the player (agent) and the team (principal) concerning the player's future performance. Because MLB players are scrutinized based on in-game performance statistics, such as batting average, hits, home runs, it is unlikely that they reduce their effort during competition. However, their effort in between games and during the off-season, which is largely unobservable, can be subject to variation. The study also acknowledges that players in the later stages of their career have less of an incentive to perform than younger players, which is in line with the findings of Sen and Rice (2011).

O'Neill (2013) used the statistic OPS as the dependent variable in his model. OPS is the summation of on-base percentage and slugging percentage, which means it evaluates how well a player hit for power and reaches base safely. He also uses OPS100, which accounts for league

and the hitter's home ballpark. This statistic is useful because it accounts for outside situations that could impact player productivity. One drawback of OPS is that it is not dependent upon playing time. To control for this, the study includes games played as a dependent variable. The study also controls for a player's position, if the player's team makes the playoffs, and the player's age. Similar to Jean (2010), O'Nneill (2013) asserts that a player's age will increase his productivity at a decreasing rate until he reaches a certain age. After this threshold, player performance will decrease because of the wear and tear on the player's body. Instead of including separate variables for age and experience like Jean (2010), O'Neill (2013) uses one quadratic model for age.

Based on its results, the study concluded that hitter do engage in opportunistic behavior. The OPS of a free agent hitter is projected to be 1.09% to 1.8% higher than his OPS in a non-contract year. Moreover, the study found that players earlier in their career are more likely to exhibit opportunistic behavior than players later in their career. Both these findings are consistent with the research conducted by previous studies in the NBA (Jean, Stiroh, and Sen & Rice). However, I disagree with the study's choice to use OPS as their dependent variable. This places a heavy weight on players' ability to get on base and hit for power, but deemphasizes hitting for average. Essentially, this is the main problem with using basic statistics as a measure of performance.

III. Analytical Framework

The dependent variable in my model is player productivity, defined as PROD. As previously stated, the contract year phenomenon is predicated on fluctuations in player effort, which are triggered by the player's ability to affect future wages. However, it is unlikely that there exists a set of metrics that perfectly measures the effort exerted by players. Therefore, the next best option to study the contract year phenomenon is to use a production metric that is a function

of effort. I chose to measure player productivity by using a advanced statistic called Defensive-adjusted Yards Above Replacement (DYAR). DYAR was created and calculated by Football Outsiders.

DYAR measures the value of a player's performance compared to the replacement level player, adjusted for situation and opponent, and then translated into yardage. When referring to the replacement level player, the statistic calculates the average level of performance of players at their respective positions. Thus, DYAR allows us to evaluate whether a player performs better or worse than the league average at his position. By translating this into yardage, we are able to examine the player's ability to maintain his level of performance. Intuitively, players who can perform at a high level while maintaining a heavy workload are valuable additions to any team. Moreover, DYAR is adjusted based on situations and strength of opponent. If a running back carries the ball one yard and scores a touchdown, he is only credited with one yard in his yardage statistic, which is considered below-average. However, DYAR weights this as an above-average play because the situation only required the running back to gain one yard. Furthermore, players face teams of different strengths every week. DYAR takes this into account by adjusting player performance based on the degree of difficulty of their matchup. Using an example from the 2017 NFL season, running for 100 yards against the Eagles (who were the top ranked run defense) is more impressive than running for 100 yards against the Redskins (who were the worst ranked run defense). In summation, DYAR allows us to quantify a player's value. In 2014, Tony Romo scored a DYAR of 1,187 yards. This means that a replacement level quarterback in the same situations as Tony Romo would have been worth 1,187 fewer yards. DYAR will be the main indication of whether players alter their effort throughout the contract cycle.

Because there are many other factors that may influence a player's performance throughout the contract cycle, it is important that my model includes the appropriate control variables. The first variable that needs to be addressed is a player's age. Based on the results from Stiroh (2007), player productivity declines with age. This is largely due to the fact that as

players age, they accumulate wear and tear on their bodies and become more susceptible to injuries. All of these factors negatively impact performance. O'Neill (2013) concurs with Stiroh (2007), but qualifies his assertion. O'Neill (2013) believes there is an intersection between age and experience, which differ in their effect on player productivity. Experience is valuable asset to any player and correlates with an increase in player performance. Historically, players record their highest DYAR ratings after they've been in the league for a few years. To account for experience when controlling for age, O'Neill (2013) uses a quadratic model to account for age. This implies that as a player gets older, their productivity increases with decreasing returns because of their gained experience. Eventually, the player reaches a certain threshold where depreciation of a player's body overcomes experience and subsequently causes player performance to suffer. While this is a valid theory, it cannot be transposed into my study. O'Neill (2013) ployed this strategy when studying MLB players, who typically have much longer careers than NFL players. The average career length of an NFL player is 3.3 years (Statista 2018), while the average career length of an MLB player is 5.6 years (Rogers 2007). Because of this, it may be difficult to find evidence of the gradual parabolic relationship that O'Neill (2013) anticipates with NFL players. Therefore, in my study I chose to use Stiroh's (2007) method for controlling for age. The age variable, defined as NAGE, is calculated by subtracting the player's age from the league average, which is 26.6 for the NFL (Elias Sports Bureau). Citing the results from Sen and Rice (2011), players are less likely to be subject to the contract year phenomenon when they are older. Thus, players who have a negative NAGE will be more likely to exhibit strategic behavior than players with a positive NAGE. The expected sign of NAGE will be negative because as players get older their DYAR ratings will subsequently suffer.

Injuries are a major part of professional sports and directly inhibit a player's ability to produce. They may also be a factor that accentuates the contract year phenomenon. Players in their contract year may be more apt to return from injuries quicker or even play through injuries to ensure they do not jeopardize their productivity and thus their future wages. Jean (2010) and

O'Neill (2013) both include games played as a control variable for injuries. Moreover, Stiroh (2007) uses minutes played as a control variable. Not only does this serve as a proxy for injuries, but it is also indicative of player performance. If a player is producing at a high level in the NBA, he will be rewarded with more minutes. Naturally, more minutes played would have a positive effect on production. Similar to Stiroh (2007), I included a variable named STARTS, which records players' games started each season. Just like minutes played, this allows me to account for injuries, but also gauge player performance. Players who are subject to the contract year phenomenon will have a greater number of games started in their contract year because it positively correlates with production. Based on this, the expected sign of STARTS is positive.

Stiroh (2007) and Jean (2010) both include team winning percentage as a control variable. A player on a team with a higher winning percentage will most likely be more productive because a player's performance is partially predicated on his teammates' performances. Because a NFL season is only comprised of 16 games, I chose to include team point differential, which is represented by TEAMPD, because I feel it will be more indicative of team performance rather than winning percentage. Point differential is the difference between the amount of points a team scores and the amount of points that are scored against it. Because a higher point differential designates a more successful team and a more successful team benefits the player, the expected sign of TEAMPD is positive. However, football contains a fundamental difference from baseball and basketball that needs to be accounted for. In football, offense and defense are never on the field at the same time. Furthermore, players exclusively play either offense or defense. This creates a disparity between the performances of the offense and the defense. Because of this, offensive players are most directly affected by the performances of other offensive players, rather than the team as a whole. To control for this, I included the variable OFFEFF, which measures a team's offensive efficiency. Offensive efficiency is calculated by valuing a team's rushing and passing production relative to the league average, and then adjusting it based on strength of

opponents. The anticipated sign of OFFEFF is positive, as a player who resides in an offense with a high offensive efficiency will see his production increase.

To study whether NFL players succumb to the contract year phenomenon, I included dummy variables for when a player is in his contract year, defined as CONTRACTYR, and for when a player is in the season following signing a new contract, defined as POSTCONTRACTYR. CONTRACTYR tests for players exhibiting strategic behavior and POSTCONTRACTYR tests for players exhibiting shrinking behavior. To determine the expected signs for my dummy variables, I refer to the studies conducted by Stiroh (2007) and Jean (2010). Through their research, both authors found evidence of strategic behavior in the NBA. Therefore, I expect that a player's productivity will be positively affected when that player is in his contract year. However, Jean (2010) finds evidence of shrinking behavior, while Stiroh (2007) does not. This inconsistency most likely can be attributed to their different methods for measuring productivity. Jean (2010) uses an advanced statistic that measures player efficiency, while Stiroh (2007) uses basic statistics such as points, rebounds, and assists. The use of basic statistics to gauge player performance can lead to skewed results because these statistics are heavily influenced by outside factors. Because I am using an advanced statistic similar to that of Jean (2010), I expect to find evidence of shrinking behavior. Thus, the anticipated sign of POSTCONTRACTYR is negative.

The population regression function estimated in my study is stated below.

$$PROD_{it} = \beta_0 - \beta_1 NAGE_{it} + \beta_2 STARTS_{it} + \beta_3 TEAMPD_{it} + \beta_4 OFFEFF_{it} + \beta_5 CONTRACTYR_{it} - \beta_6 POSTCONTRACTYR_{it} + \varepsilon_i$$

IV. Data

Contract and free agency data for my study was collected from the website Spotrac. Their database includes a yearly breakdown of free agent signings along with their contract details. My dataset includes players who signed contracts under the NFL's most recent Collective Bargaining

Agreement, which spans from 2011 to 2017. Because there is a lack of performance statistics for defensive and auxiliary offensive players, my study was narrowed down to running backs, wide receivers, and quarterbacks. Furthermore, I only included players who signed at least three year contracts, based on the theory presented by Sen and Rice (2011). These authors stated that players are willing to sacrifice compensation for contract length, which serves as a sense of security. Players who sign short-term or one year contracts will be devoid of the aforementioned security and will have no opportunity to exhibit opportunistic behavior as they are constantly eyeing contract expiry. Therefore, I believe that players who signed at least three year contracts were the most influenced by the contract year phenomenon, as they have an opportunity to discount the future and subsequently fluctuate effort. It is also worth noting that Stiroh (2007) and Jean (2010) limited their data set to players who signed multi-year contracts for the same reason. Finally, practice players, rookies, and back-up players were all excluded from my study due to the lack of performance data available on them.

My final dataset includes 59 NFL players (25 running backs, 3 quarterbacks, and 31 wide receivers) from the 2011-2017 free agent classes. Player data was taken from 2007-2017. Summary statistics for my dataset can be found in Table 1. The mean age of players included in my study was 27.3, which is slightly above the league average age of 26.6, while the average number of games started each year was 9.4. The mean DYAR score was 95.1, with a standard deviation of 145.8. If we break the dataset down by position, quarterbacks scored the best mean DYAR rating (187.1), followed by wide receivers (103.3), and running backs (63.7). Furthermore, on average quarterbacks started the most games per year (11.5), followed by wide receivers (9.5) and running backs (8.2). This is consistent with the data on career length by position, as the average career length of quarterback is 4.44 years, while the average career length for a wide receiver and running back is 2.81 and 2.57 respectively (Statista 2018).

Moreover, descriptive statistics for players in their contract year versus their non-contract years can be found in Table 2. The mean number of starts for a player in his contract year (11.3)

is greater than when in a non-contract year (8.6). This is consistent with the theory that players in a contract year are rewarded with more starts because they are more productive. Also, it is consistent with the idea that players are healthier, or play through injury more, in a contract year as opposed to other years. In regards to production, players in their contract year recorded a DYAR rating of 134.1, which is much greater than their DYAR rating in non-contract years (65.7). Additionally, mean team point differential (15.7) and offensive efficiency (2.5) are greater in a player's contract year than in a non-contract year. This is in accordance with the previous literature and expected signs of the regression function. Although preliminary, these statistics may provide an indication that players are influenced by the contract year phenomenon.

None of the previously mentioned literature studied the contract year phenomenon's effects on different positions in their respective sport. Regardless of the sport, each position is fundamentally different from the rest. Because of this, teams place different values on different positions. For example, quarterbacks and defensive ends are viewed as the most valuable positions for an NFL team, thus they are usually the highest compensated players. This is important when studying the contract year phenomenon because compensation is a primary motivation factor when players engage in opportunistic behavior. Therefore, quarterbacks may be more inclined to exhibit strategic behavior than tight ends because they have a higher salary ceiling. To incorporate this into my study, I will utilize four models. Each model will consist of the same variables and expected signs, but will differ in regards to the dataset being tested. Model 1 will test my complete dataset of running backs, wide receivers, and quarterbacks, Model 2 will test a dataset of just running backs, Model 3 will test a dataset of just wide receivers, and Model 4 will test a dataset of wide receivers and running backs. This will allow me to test whether certain positions, or group of positions, are more susceptible to the contract year phenomenon. Wide receivers and running backs were grouped together in Model 4 because of their similar statistics, per Table 1. I decided against including a model that consisted of just quarterbacks because there

was not enough observations from players at this position. Additionally, this method of testing four models with different datasets will serve as a robustness check for my regression function.

Each of the models will be a fixed effects model. Jean (2010), Sen and Rice (2011), and Stiroh (2007) all use fixed effects models in their studies. The reason for using fixed effects models is because they can control for an extraneous variable within individuals that could influence the predictor variable. In this case, the fixed effects accounts for any unobserved differences in ability between individual players that may impact their productivity, or DYAR rating.

V. Results

A full table of results for each model can be found in Table 3. The degrees of freedom for all the models tested are well above 30. Moreover, the total R^2 value for the models range from 26.9% to 38.2%. A variance inflation factors (VIF) test of my variables was conducted to test for multicollinearity. Per the results listed in Table 4, all of the variables VIF values were below 5, indicating that there is no multicollinearity present.

The regression yielded negative coefficients for NAGE, implying that as players move further away from the league average age (26.6) their production suffers. This finding is consistent with all of the previous literature. Especially Sen and Rice (2011), who asserted that older players at a certain point in their contract cycle perform a certain percentage worse than younger players at that same point in their contract cycle. However, only Model 2,3, and 4 reported statistically significant p-values for NAGE. The common denominator for those models is that they all excluded quarterbacks. Quarterbacks may have affected NAGE in Model 1 because players at this position typically have longer careers than running backs and wide receivers. As previously mentioned, the average career length of a quarterback (4.44 years) is greater than that of a running back (2.57) and wide receiver (2.81) (Statista 2018). This suggests that a QB's production is not as influenced by aging compared to other positions. Examples of this are quarterbacks like

Drew Brees and Tom Brady who, despite being in their late 30's and early 40's, consistently rank within the top five quarterbacks, in terms of DYAR, each season.

Games started was one of the most consistent and statistically significant variables amongst the models. STARTED recorded positive coefficients that were statistically significant at the 1% level in each model. This was in accordance with the expected sign of STARTED based on the literature. Essentially, players have to be on the field in order to produce and increase their DYAR ratings. While STARTED served as a proxy for injuries, it also controlled for performance because more productive players will be rewarded with more starts. Based on these results, injuries will have a negative effect on player's performance because they inhibit the player's on-field performance. Further, by starting more games, this indicates that the player has been productive and also gives him an opportunity to continue to be productive. Naturally, this will positively affect a player's DYAR rating. Because this coefficient was significant in all models, we can assume that regardless of position, player performance is positively affected by more games started.

TEAMPD and OFFEFF, which were variables that were included to serve as a proxy for team performance, yielded mixed results. Per the literature, I expected team point differential, the holistic team measure, to have a positive effect on production. Simply put, if a player is a part of a successful team, he will be put in more conducive situations to increase his productivity. To reference Stiroh (2007), a basketball player's assist numbers are contingent on his teammate's ability to score, which correlates with the team's overall success. TEAMPD yielded very low, insignificant coefficients for all four models, demonstrating that it does not affect player productivity. On the other hand, offensive efficiency produced positive coefficients that were statistically significant at the 1% level. This disparity between the two variables is likely attributed to the fundamental difference between football and other sports. Because offense and defense are never on the field at the same time, offensive players' performances are correlated to their fellow offensive teammates. A running back's production is exponentially more influenced by his

offensive line's ability to block opposing defenders than his team defense's ability to defend the opposing offense. Based on this, it is clear why offensive players' production is predicated on offensive efficiency, much more so than overall team performance.

Stiroh (2007), Jean (2010), Sen and Rice (2011), and O'Neill (2013) all reported results that found evidence of strategic behavior in two other professional sports. Because of their results, I anticipated that CONTRACTYR would be positive. While the regression produced the expected coefficients for CONTRACTYR in all four models, none of the p-values revealed significant results. As for POSTCONTRACTYR, the results from Jean (2010) led me to anticipate a negative sign on the variable. Again, POSTCONTRACTYR yielded the correct coefficient, but had no statistically significant p-values. This implies that while the expected signs of these variables were reported, there was no statistically significant results that found evidence of strategic or shrinking behavior in the NFL.

VI. Discussion

I believe that my study did not find evidence of the contract year phenomenon because of the current nature of NFL contracts. When looking at NBA and MLB contracts, the amount of guaranteed money included is anywhere from 80% to 100% for a vast majority of players. Whereas in the NFL, average players receive contracts that contain anywhere from 30% to 50% guaranteed money. Tom Brady, one of the best quarterbacks in the NFL, most recently signed a contract that only contained about 65% guaranteed money. Essentially, all NFL players, including the upper echelon players, must earn a sizeable portion of their salary through incentives. Based on this, players are motivated to continually perform throughout their contract cycle because incentives serve as opportunities for them to earn additional cash.

Looking at how contracts have evolved since the start of the century, especially since the 2011 Collective Bargaining Agreement, it is clear that there is a paradigm shift. As previously mentioned, NFL contracts continue to offer high salaries, more guaranteed money, and more

player benefits than ever before. One reason could be the recent discoveries of the dangers associated with playing football. More specifically, continual blows to the head that occur many times throughout a player's football career has been linked to the development of Chronic Traumatic Encephalopathy (CTE). Recently, many current and former NFL players have been outspoken about the dire effects that CTE and concussions have had on them. This is leading many to question if people will continue to play football when considering the negative health effects. The average life expectancy of an NFL player is 55 years old (St. Petersburg Times). Because of this, NFL players are adamantly demanding increased benefits for essentially risking their lives to play the sport. If NFL teams do not adhere to these growing demands, they may slowly usher in the demise of the sport.

In 2017, Kirk Cousins, an NFL quarterback, received the first fully guaranteed NFL contract. Not only was this deal a product of the growing evolution of contracts, but it will serve as a catalyst for the further development of player-friendly contracts. The next CBA, which is set for 2020, will likely continue the trend of increasing the minimum guaranteed money in contracts and providing additional player benefits. If contracts continue to evolve in this direction, they will become closer to mirroring those of the MLB and NBA. Based on the results of contract year phenomenon studies in those leagues, this leads me to believe that strategic and shrinking behavior in the NFL will accentuate as contracts continue down this cycle. If this is the case, NFL teams will have to find ways other than incentives to deter players from exhibiting strategic behavior.

VII. Limitations and Future Work

One of the main limitations with my study was the small sample size of players that was tested. Moreover, there was only three quarterbacks included in my study, which was much less than the number of running backs and wide receivers included. However, this was unavoidable based on the nature of my study. I wanted to find evidence of the contract year phenomenon on

players who signed contracts under the 2011 CBA. This limited me to just seven free agent classes that consisted of 59 players in total. I debated on expanding my study to include players that signed contracts under the 2006 and 2011 CBAs as a means of increasing my sample size; however, I felt that this could possibly ruin the integrity of my study. After reading the contract changes outlined in the 2006 CBA and reviewing player contracts signed under this agreement, it was evident that the 2006 CBA did not make enough major changes to contracts that would make them favorable enough to elicit opportunistic behavior from players.

For future works, it would be interesting to study the evolution of opportunistic behavior in the NFL over the past two decades. While contracts may not currently be able to evoke strategic and shrinking behavior in players, they have progressed exponentially since the early 2000s. When considering this, I would like to find a way to analyze if the contract year phenomenon is more prevalent since the 2011 CBA when comparing it to previous decades. Player contracts in previous decades contained a miniscule amount of guaranteed money when compared to player contracts since the 2011 CBA. Therefore, I would hypothesize that opportunistic behavior is more present in the NFL since the 2011 CBA than in years preceding it. This would also be in line with my assertion that NFL contracts continually evolution will induce more and more players to succumb to the contract year phenomenon.

VIII. Tables

TABLE 1: Summary Statistics

	Observations	Mean	Standard Deviation	Minimum	Maximum
Running Backs					
Age	157	27.1	2.7	21.0	34.0
Games Started	157	8.2	5.8	0.0	16.0
Team Point Differential	157	-7.7	101.1	-261.0	208.0
Offensive Efficiency	157	-0.8	15.2	-32.5	45.3
DYAR	157	63.7	92.8	-125.0	382.0
Wide Receivers					
Age	218	27.4	3.4	21.0	37.0
Games Started	218	9.5	5.7	0.0	16.0
Team Point Differential	218	34.9	103.5	-214.0	226.0
Offensive Efficiency	218	2.1	14.9	-45.7	33.0
DYAR	218	103.3	114.4	-114.0	481.0
Quarterbacks					
Age	21	27.8	3.0	22.0	33.0
Games Started	21	11.5	5.8	0.0	16.0
Team Point Differential	21	67.2	82.3	-93.0	207.0
Offensive Efficiency	21	0.9	13.5	-25.3	26.7
DYAR	21	187.1	408.4	-558.0	1022.0
Total					
Age	396	27.3	3.0	21.0	37.0
Games Started	396	9.4	5.7	0.0	16.0
Team Point Differential	396	15	103.8	-261.0	226.0
Offensive Efficiency	396	1	15.1	-45.7	45.3
DYAR	396	95.1	145.8	-558.0	1022.0

TABLE 2: Descriptive Statistics for Contract Versus Non-Contract Year

	Observations	Mean	Standard Deviation	Minimum	Maximum
Contract Year					
Age	60	27.1	2.0	24.0	33.0
Games Started	60	11.3	4.8	0.0	16.0
Team Point Differential	60	15.7	108.0	-214.0	208.0
Offensive Efficiency	60	2.5	16.0	-45.7	39.0
DYAR	60	134.1	129.1	-86.0	479.0
Non-contract Year					
Age	336	26.3	2.5	21.0	32.0
Games Started	336	8.6	5.6	0.0	16.0
Team Point Differential	336	0.6	104.5	-202.0	208.0
Offensive Efficiency	336	-0.2	16.4	-28.8	39.0
DYAR	336	65.7	86.2	39.0	300.0

TABLE 3: Table of Results

	Model (1) Total	Model (2) RB	Model (3) WR	Model (4) RB/WR
Dep var PROD				
NAGE	-4.1 (3.0)	-10.0*** (3.1)	-6.6** (3.3)	-7.4*** (2.5)
STARTS	9.0*** (1.4)	5.9*** (1.4)	10.8*** (1.5)	9.4*** (1.2)
TEAMPD	-0.1 (0.1)	-0.1 (0.1)	0.1 (0.1)	0.1 (0.1)
OFFEFF	4.0*** (0.7)	2.9*** (0.6)	3.5*** (0.7)	3.2*** (0.5)
CONTRACTYR	14.0 (17.6)	8.1 (17.8)	16.2 (18.6)	10.1 (14.9)
POSTCONTRACTYR	-13.7 (17.6)	-4.8 (17.8)	-2.3 (18.8)	-0.1 (12.6)
Cons	8.8 (14.7)	20.8 (13.4)	-6.4 (16.4)	1.1 (12.6)
N	397	156	217	304
R^2	26.9%	30.1%	38.2%	35.7%

* indicates significance at the 10% level
** indicates significance at the 5% level
*** indicates significance at the 1% level

TABLE 4: VIF Results (Models 1-4)

Model 1 (Total)

	VIF	1/VIF
NAGE	1.04	0.40
STARTS	1.06	0.41
TEAMPD	2.43	0.93
OFFEFF	2.44	0.94
CONTRACTYR	1.07	0.94
POSTCONTRACTYR	1.06	0.96
Mean VIF	1.51	

Model 2 (RB)

	VIF	1/VIF
NAGE	1.06	0.94
STARTS	1.04	0.95
TEAMPD	2.21	0.45
OFFEFF	2.23	0.44
CONTRACTYR	1.07	0.93
POSTCONTRACTYR	1.06	0.94
Mean VIF	1.44	

Model 3 (WR)

	VIF	1/VIF
NAGE	1.03	0.96
STARTS	1.07	0.93
TEAMPD	2.70	0.36

OFFEFF	2.70	0.37
CONTRACTYR	1.07	0.93
POSTCONTRACTYR	1.07	0.92
Mean VIF	1.61	

Model 4 (WR/RB)

	VIF	1/VIF
NAGE	1.03	0.97
STARTS	1.05	0.95
TEAMPD	2.46	0.40
OFFEFF	2.47	0.40
CONTRACTYR	1.06	0.93
POSTCONTRACTYR	1.07	0.93
Mean VIF	1.52	

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